# GATE 2014: General Instructions during Examination

1. Total duration of the GATE examination is **180** minutes.
2. The clock will be set at the server. The countdown timer at the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You need not terminate the examination or submit your paper.
3. Any useful data required for your paper can be viewed by clicking on the **Useful Common Data** button that appears on the screen.
4. Use the scribble pad provided to you for any rough work. Submit the scribble pad at the end of the examination.
5. You are allowed to use a non-programmable type calculator, however, sharing of calculators is not allowed.
6. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:

| 1 | You have not visited the question yet. |
|---|---|
| 3 | You have not answered the question. |
| 5 | You have answered the question. |
| 7 | You have NOT answered the question, but have marked the question for review. |
| 9 | You have answered the question, but marked it for review. |

The **Marked for Review** status for a question simply indicates that you would like to look at that question again. *If a question is answered, but marked for review, then the answer will be considered for evaluation unless the status is modified by the candidate.*

**Navigating to a Question :**

7. To answer a question, do the following:
    a. Click on the question number in the Question Palette to go to that question directly.
    b. Select an answer for a multiple choice type question by clicking on the bubble placed before the 4 choices, namely A, B, C and D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
    c. Click on **Save & Next** to save your answer for the current question and then go to the next question.
    d. Click on **Mark for Review & Next** to save your answer for the current question and also mark it for review, and then go to the next question.

**Caution:** Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on a question number without saving the answer to the previous question.

You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

### Answering a Question :

8. Procedure for answering a multiple choice (MCQ) type question:
   a. Choose one answer from the 4 options (A,B,C,D) given below the question, click on the bubble placed before the chosen option.
   b. To deselect your chosen answer, click on the bubble of the chosen option again or click on the **Clear Response** button.
   c. To change your chosen answer, click on the bubble of another option.
   d. To save your answer, you MUST click on the **Save & Next** button.

9. Procedure for answering a numerical answer type question:
   a. To enter a number as your answer, use the virtual numerical keypad.
   b. A fraction (e.g. -0.3 or -.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or -932.6711 or 12.82 can be entered.
   c. To clear your answer, click on the **Clear Response** button.
   d. To save your answer, you MUST click on the **Save & Next** button

10. To mark a question for review, click on the **Mark for Review & Next** button. *If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is* **Marked for Review**, *that answer will be considered in the evaluation unless the status is modified by the candidate.*

11. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.

12. Note that ONLY Questions for which answers are *saved* or *marked for review after answering* will be considered for evaluation.

### Choosing a Section :

13. Sections in this question paper are displayed on the top bar of the screen. Questions in a Section can be viewed by clicking on the name of that Section. The Section you are currently viewing will be highlighted.

14. A checkbox is displayed for every optional Section, if any, in the Question Paper. To select the optional Section for answering, click on the checkbox for that Section.

15. If the checkbox for an optional Section is not selected, the **Save & Next** button and the **Mark for Review & Next** button will NOT be enabled for that Section. You will

only be able to see questions in this Section, but you will not be able to answer questions in the Section.

16. After clicking the **Save & Next** button for the last question in a Section, you will automatically be taken to the first question of the next Section in sequence.

17. You can move the mouse cursor over the name of a Section to view the answering status for that Section.

## Changing the Optional Section :

18. After answering the chosen optional Section, partially or completely, you can change the optional Section by selecting the checkbox for a new Section that you want to attempt. A warning message will appear along with a table showing the number of questions answered in each of the previously chosen optional Sections and a checkbox against each of these Sections. Click on a checkbox against a Section that you want to reset and then click on the **RESET** button. Note that RESETTING a Section will DELETE all the answers for questions in that Section. Hence, if you think that you may want to select this Section again later, you will have to note down your answers for questions in that Section. If you do not want to reset the Section and want to continue answering the previously chosen optional Section, then click on the **BACK** button.

19. If you deselect the checkbox for an optional Section in the top bar, the following warning message will appear: "Deselecting the checkbox will DELETE all the answers for questions in this Section. Do you want to deselect this Section?" If you want to deselect, click on the **RESET** button. If you do not want to deselect, click on the **BACK** button.

20. You can shuffle between different Sections or change the optional Sections any number of times.

# GATE 2014 Examination

# PI: Production & Industrial Engineering

*Duration*: **180 minutes**                                                        *Maximum Marks*: **100**

**Read the following instructions carefully.**

1. To login, enter your Registration Number and password provided to you. Kindly go through the various symbols used in the test and understand their meaning before you start the examination.

2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **View All Questions** button in the screen.

3. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory.
   The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each.
   The subject specific GATE paper section consists of **55** questions, out of which question numbers 1 to 25 are of 1-mark each, while question numbers 26 to 55 are of 2-mark each.

4. Depending upon the GATE paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Common Data** button that appears at the top, right hand side of the screen.

5. The computer allotted to you at the examination center runs specialized software that permits only one answer to be selected for multiple-choice questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual keyboard and mouse.

6. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.

7. In each paper a candidate can answer a total of 65 questions carrying 100 marks.

8. The question paper may consist of questions of **multiple choice type** (MCQ) and **numerical answer type**.

9. Multiple choice type questions will have four choices against A, B, C, D, out of which only **ONE** is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (◯) placed before the choice.

10. For numerical answer type questions, each question will have a numerical answer and there will not be any choices**. For these questions, the answer should be entered**by using the virtual keyboard that appears on the monitor and the mouse.

11. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of ⅓ marks for a 1-mark question and ⅔ marks for a 2-mark question.

12. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.

13. Non-programmable type Calculator is allowed. Charts, graph sheets, and mathematical tables are **NOT** allowed in the Examination Hall. You must use the Scribble pad provided to you at the examination centre for all your rough work. The Scribble Pad has to be returned at the end of the examination.

**Declaration by the candidate:**

"I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also confirm that at the start of the examination all the computer hardware allotted to me are in proper working condition".

## Q. 1 – Q. 5 carry one mark each.

Q.1    Choose the most appropriate word from the options given below to complete the following sentence.

A person suffering from Alzheimer's disease _____ short-term memory loss.

(A) experienced                              (B) has experienced
(C) is experiencing                          (D) experiences

Q.2    Choose the most appropriate word from the options given below to complete the following sentence.

_____ is the key to their happiness; they are satisfied with what they have.

(A) Contentment        (B) Ambition        (C) Perseverance        (D) Hunger

Q.3    Which of the following options is the closest in meaning to the sentence below?

"As a woman, I have no country."

(A) Women have no country.
(B) Women are not citizens of any country.
(C) Women's solidarity knows no national boundaries.
(D) Women of all countries have equal legal rights.

Q.4    In any given year, the probability of an earthquake greater than Magnitude 6 occurring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is ____ years.

Q.5    The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?

(A) 3-4 years          (B) 4-5 years          (C)  5-6 years          (D)  6-7 years

## Q. 6 – Q. 10 carry two marks each.

Q.6    In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?
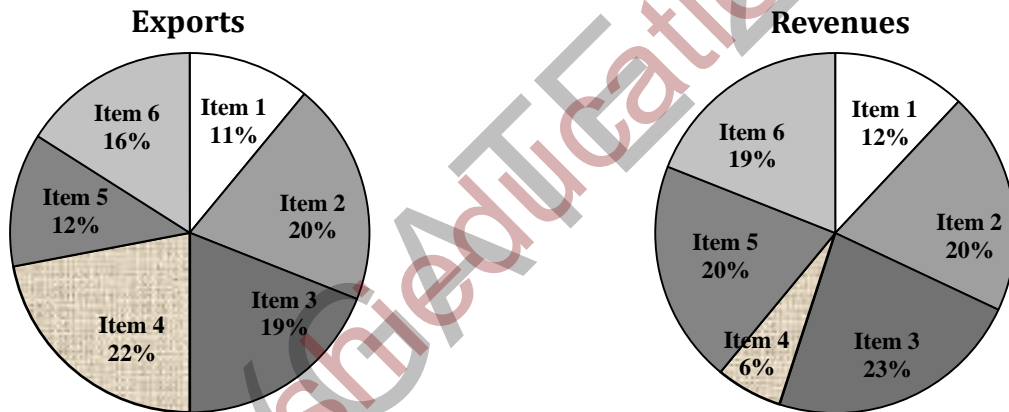       **Statements**
                  1.   Shiv is younger to Riaz.
                  2.   Shiv is elder to Som.

(A) Statement 1by itself determines the eldest child.
(B) Statement 2 by itself determines the eldest child.
(C) Statements 1 and 2 are both required to determine the eldest child.
(D) Statements 1 and 2 are not sufficient to determine the eldest child.

Q.7   Moving into a world of big data will require us to change our thinking about the merits of exactitude. To apply the conventional mindset of measurement to the digital, connected world of the twenty-first century is to miss a crucial point. As mentioned earlier, the obsession with exactness is an artefact of the information-deprived analog era. When data was sparse, every data point was critical, and thus great care was taken to avoid letting any point bias the analysis.
*From "BIG DATA" Viktor Mayer-Schonberger and Kenneth Cukier*

The <u>main</u> point of the paragraph is:

(A) The twenty-first century is a digital world
(B) Big data is obsessed with exactness
(C) Exactitude is not critical in dealing with big data
(D) Sparse data leads to a bias in the analysis

Q.8   The total exports and revenues from the exports of a country are given in the two pie charts below. The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 5 lakh tonnes and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of Item 1 per kilogram to the revenue generated through export of Item 4 per kilogram?

**Exports**

Item 6 16%
Item 1 11%
Item 5 12%
Item 2 20%
Item 4 22%
Item 3 19%

**Revenues**

Item 6 19%
Item 1 12%
Item 5 20%
Item 2 20%
Item 4 6%
Item 3 23%

(A) 1:2          (B) 2:1          (C) 1:4          (D) 4:1

Q.9   X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is 1 km east of P. What is the distance between X and Q in km?

(A) 1          (B) $\sqrt{2}$          (C) $\sqrt{3}$          (D) 2

Q.10  10% of the population in a town is $HIV^+$. A new diagnostic kit for HIV detection is available; this kit correctly identifies $HIV^+$ individuals 95% of the time, and $HIV^-$ individuals 89% of the time. A particular patient is tested using this kit and is found to be positive. The probability that the individual is actually positive is _____

**END OF THE QUESTION PAPER**

**Q. 1 – Q. 25 carry one mark each.**

Q.1     The system of equations, given below, has

$$x+2y+4z=2$$
$$4x+3y+z=5$$
$$3x+2y+3z=1$$

(A)  a unique solution                          (B)  two solutions

(C)  no solution                                (D)  more than two solutions

Q.2     Directional derivative of $\varphi = 2xz - y^2$, at the point (1, 3, 2), becomes maximum in the direction of

(A) $4i + 2j - 3k$         (B) $4i - 6j + 2k$         (C) $2i - 6j + 2k$         (D) $4i - 6j - 2k$

Q.3     A metallic sphere of 0.1 *m* diameter has a thermal conductivity of 10 *W/m-K*. If the fluid flowing around it has a heat transfer coefficient of 10 *W/m²-K* and thermal conductivity of 0.4 *W/m-K,* the value of *Biot* number is _____

Q.4     A quantitative measure of maintainability is

(A)  Downtime                                   (B)  Mean Time Between Failure

(C)  Mean Time To Repair                         (D)  System availability

Q.5     Which one of the following techniques is used to analyze the cause and effect of product failure?

   (A)  Quality Function Deployment

   (B)  Fault Tree Analysis

   (C)  Value Analysis

   (D)  Failure Mode and Effect Analysis

Q.6     As the product passes through different stages of product life cycle, the product variety

(A)  increases                                   (B)  decreases and then increases

(C)  remains the same                            (D)  decreases

Q.7    A machine has been purchased for *Rs.*100,000 and its useful life is estimated to be 10 *years*. Its scrap value at the end of 10 *years* is estimated as *Rs.*20,000. If the depreciation is determined using the declining balance method, the value of depreciation (in *Rs.*) during the first year is _____

Q.8    A company wants to determine the proportion of time workers are idle. In a pilot study, the proportion of idle time was found to be 0.16. If the company wants to be 95% confident (z-value = 1.96) that the estimated value is within 0.03 of the true proportion, the number of observations required in the study should be _____

Q.9    A manufacturing plant, working in 2 shifts of 8 *hrs* each, produces 30,000 switch boards using a set of 7 workstations in series. The cycle time, in *seconds*, is _____

Q.10   A simple random sample of 100 observations was taken from a large population. The sample mean and the standard deviation were determined to be 80 and 12, respectively. The standard error of mean is _____

Q.11   The diameter of a shaft must be within a tolerance of 0.02 of the nominal diameter. Which control chart is useful to determine that the process is in statistical control?

(A)  p chart                                          (B)  c chart

(C)  $\overline{X}$ and R chart                      (D)  U chart

Q.12   Which one of the following is not a characteristic of JIT manufacturing system?

(A)  Reduction of lot sizes                           (B)  Efficient use of buffer inventory

(C)  Small but frequent deliveries                    (D)  Higher productivity

Q.13   Relationship between Young's Modulus (*E*), Shear Modulus (*G*), and Poisson's Ratio (*μ*), for a material obeying the Hooke's Law, is

(A) $E = \dfrac{G}{(2+\mu)}$        (B) $E = \dfrac{2G}{(1+\mu)}$        (C) $E = G(1+\mu)$        (D) $E = 2G(1+\mu)$

Q.14 For a metal alloy, which one of the following descriptions relates to the **stress-relief annealing** process?

    (A) Heating the workpiece material above its recrystallization temperature, soaking and then cooling in still air

    (B) Heating the workpiece material below its recrystallization temperature, holding for some time and then furnace cooling

    (C) Heating the workpiece material up to its recrystallization temperature and then rapid cooling

    (D) Heating the workpiece up to its recrystallization temperature and cooling to room temperature alternately for a few cycles

Q.15 Generative Approach of Computer Aided Process Planning is **NOT** based on

    (i)   part coding using Group Technology    (ii) part feature recognition and extraction
    (iii) database of standard process plans for    (iv) geometric modelling of part
         part families

  (A) (i) and (ii)       (B) (i) and (iii)    (C) (i),(ii) and (iii)    (D) (i), (ii) and (iv)

Q.16 Which one of the following methods is **NOT** used for producing metal powders?

    (A) Atomization                (B) Compaction

    (C) Machining and grinding      (D) Electrolysis

Q.17 In an open loop, point-to-point controlled CNC drilling machine, a stepper motor, producing 200 angular steps per revolution, drives the table of a drilling machine by one angular step per each pulse generated by a pulse generator (shown in figure). Each angular step moves the table by one Basic Length Unit (BLU) along X axis with a lead screw having a pitch of 4 mm. If the frequency of pulse generator is doubled, the BLU will
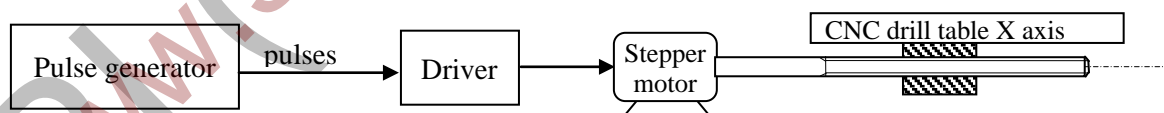


    (A) become double of previous value

    (B) become half of previous value

    (C) remain the same

    (D) become zero

Q.18    A spindle speed of 300 *rpm* and a feed of 0.3 *mm/revolution* are chosen for longitudinal turning operation on an engine lathe.  In finishing pass, roughness on the work surface can be reduced  by

(A)  reducing the spindle speed

(B)  increasing the spindle speed

(C)  reducing the feed of tool

(D)  increasing the feed of tool

Q.19    *Chills* are used in casting moulds to

(A)  achieve directional solidification

(B)  reduce the roughness of top surface of the cast product

(C)  increase the solidification time

(D)  reserve excess molten metal

Q.20    A moving *mandrel* is used in

(A)  wire drawing          (B)  forging          (C)  tube drawing          (D)  bending

Q.21    *Brazing* and *Soldering* are

(A)  plastic joining methods

(B)  homogeneous joining methods

(C)  autogenous joining methods

(D)  heterogeneous joining methods

Q.22    Match the following:

|  | Group I (Mechanism) |  | Group II (Machines) |
|---|---|---|---|
| P | Quick return | 1 | Lathe |
| Q | Apron | 2 | Shaping |
| R | Intermittent indexing | 3 | Gear hobbing |
| S | Differential mechanism | 4 | Milling |

(A)  P1-Q2-R4-S3          (B)  P2-Q1-R4-S3          (C)  P4-Q1-R2-S3          (D)  P2-Q3-R1-S4

Q.23    *Reaming* is a process used for

   (A) creating a circular hole in metals

   (B) cutting a slot on the existing hole surface

   (C) finishing an existing hole surface

   (D) making non-circular holes in metals

Q.24    Find the correct combination of manufacturing processes to produce the part, shown in figure, from a blank (holes shown are with square and circular cross-sections).
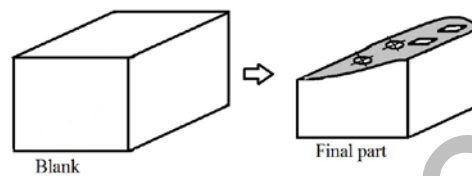


   (A) Drilling and milling on column and knee type universal milling machine

   (B) Die-sinking and CNC Wire-cut EDM process

   (C) Die-sinking and CNC drilling

   (D) CNC Wire-cut EDM process only

Q.25    In an open die forging, a circular disc is gradually compressed between two flat platens. The exponential decay of normal stress on the flat face of the disc, from the center of the disc towards its periphery, indicates that

   (A) there is no sticking friction anywhere on the flat face of the disc

   (B) sticking friction and sliding friction co-exist on the flat face of the disc

   (C) the flat face of the disc is frictionless

   (D) there is only sticking friction on the flat face of the disc

## Q. 26 – Q. 55 carry two marks each.

Q.26    If $\varphi = 2x^3 y^2 z^4$ then $\nabla^2 \varphi$ is

(A) $12xy^2 z^4 + 4x^2 z^4 + 20x^3 y^2 z^3$

(B) $2x^2 y^2 z + 4x^3 z^4 + 24x^3 y^2 z^2$

(C) $12xy^2 z^4 + 4x^3 z^4 + 24x^3 y^2 z^2$

(D) $4xy^2 z + 4x^2 z^4 + 24x^3 y^2 z^2$

Q.27    Using the Simpson's 1/3$^{rd}$ rule, the value of $\int y dx$ computed, for the data given below, is _____

| $x$ | 1 | 3 | 5 |
|-----|---|---|---|
| $y$ | 2 | 6 | 4 |

Q.28    If the equation $\sin(x) = x^2$ is solved by Newton Raphson's method with the initial guess of $x=1$, then the value of $x$ after 2 iterations would be _____

Q.29    If 2 *kg* mass of water, with a specific heat of 4.18 *kJ/kg-K,* is heated from $20°C$ to $40°C$ in an open container, then the change in entropy of water, in *kJ/K,* is _____

Q.30    A gas at a pressure of 500 *kPa* and volume of 0.75 $m^3$ is contained in a cylinder-piston assembly. When the piston moves slowly in the cylinder, the pressure inside the cylinder varies as $V^{-1.2}$. If the final volume of gas becomes doubled, then the work done by the gas, in *kJ,* is _____

Q.31    Two geometrically identical metallic bars are joined end to end (as shown in Fig.). Bars *P* and *Q* have thermal conductivities of 5 *W/m-K* and 10 *W/m-K* respectively. The free end of the Bar *P* is kept at $40°C$, while that of Bar *Q* is at $10°C$.
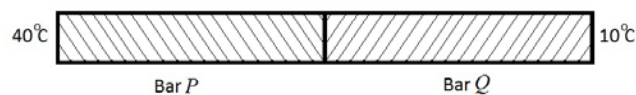


The junction temperature (in $°C$) for steady state heat flow is _____

Q.32    A metallic sphere of 1 *kg* mass, with surface area of 0.0314 $m^2$, is maintained at an initial temperature of $50°C$. The fluid circulating around the sphere is maintained at a temperature of $10°C$. Specific heat of metallic sphere is 314 *J/kg-K* and the heat transfer coefficient between the fluid and the sphere is 10 $W/m^2$-*K*. The time taken (in *seconds*) for the sphere to cool down to $20°C$ is _____

Q.33   An element, shown below, is subjected to stresses:   $\sigma_x = 5\ kN/mm^2$, $\sigma_y = 3\ kN/mm^2$ and $\tau = 1\ kN/mm^2$. The magnitudes and direction of principal stresses   $\sigma_1$, $\sigma_2$   (in $kN/mm^2$) and $\varphi$ (in *degrees*) are
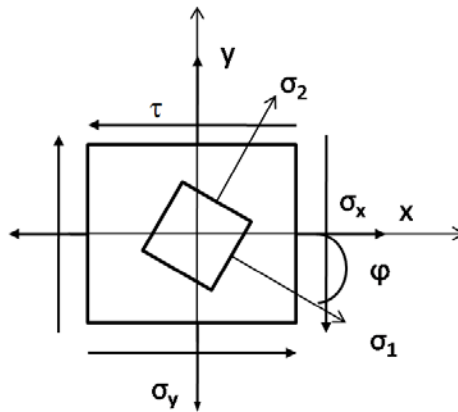


(A)  5.41, 2.58, –22.5   (B)  5.41, 2.58, –45      (C)  5.0, 3.0, –22.5      (D)  4.0, 4.0, –22.5

Q.34   Each axis of NC machine is driven by a stepper motor drive with a lead screw. The pitch of lead screw is *p mm*. The step angle of stepper motor per pulse input is *α degrees/pulse.* The ratio of gear drive in stepper motor drive is *g* (number of turns of the motor for each single turn of the lead screw). The number of pulses required to achieve a linear movement of *x mm* is

(A) $\dfrac{\alpha g}{360 p} x$      (B)  $\dfrac{360 g}{p} x$      (C) $\dfrac{g}{360 p} x$      (D) $\dfrac{360 g}{p\alpha} x$

Q.35   A uniformly distributed load (q) of 1500 *N/m* is applied on a simply supported beam LMN with an overhang of 0.5 *m*. Which one of the following statements is **FALSE**?
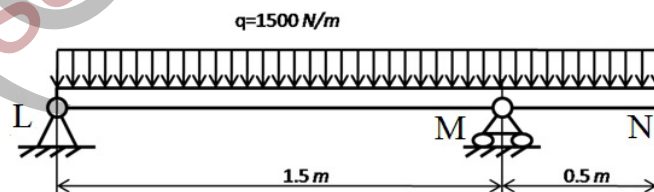


(A)  Reaction forces at L and M are 1 *kN* and 2 *kN*

(B)  Bending moment is zero at the points L, N and at a point in between L and M

(C)  The bending moment is zero at points L and N only

(D)  The shear force is zero at points L, N and at a point in between L and M

Q.36    A CNC instruction G91G01X30Y40F100 commands the movement of tool along the path at a feed
        rate of 100 *mm/min* (G91- incremental format and G01- linear interpolation). The feed rate of the
        tool (in *mm/min*) along the *X* axis will be _____

Q.37    Elastic moduli of a fibre reinforced plastic composite and fibres are 200 *GPa* and 400 *GPa,*
        respectively. The longitudinal fibres are taking up 50% of the load. Assuming the area fraction
        equal to the volume fraction, the volume fraction of the fibres will be _____

Q.38    The processing times and the due dates of 4 independent jobs processed by a single machine in a
        shop are given in the table.

| Job | Processing Time (in *days*) | Due Date (in *days*) |
|-----|------|------|
| 1 | 4 | 6 |
| 2 | 7 | 9 |
| 3 | 2 | 18 |
| 4 | 8 | 15 |

        The average lateness of the jobs (in *days*) following the Shortest Processing Time (SPT) rule is
        _____

Q.39    The annual requirement of a raw material item is 10,000 units. The holding cost of inventory for the
        item is 80 *paise* per unit per year and the ordering cost is *Rs.* 40 per order. The order quantity
        presently is 800 units per order. Assume that there are no other costs. Which one of the following
        observations is **CORRECT**?

         (A) The order quantity is optimal and total ordering cost is equal to total holding cost.

         (B) The order quantity is optimal and total ordering cost is more than total holding cost.

         (C) The order quantity is not optimal and total ordering cost is equal to total holding cost.

         (D) The order quantity is not optimal and total ordering cost is more than total holding cost.

Q.40    In a single-server queuing system, arrivals are Poisson distributed with a mean of 16 *per hour* and
        the exponential service time is 3 *minutes per person* on the average. What would be the expected
        number of persons in the queue (Lq) for the queue disciplines of First-come-first-serve (FCFS) and
        Last-come-first serve (LCFS)?

         (A)  4.0, 4.0                                    (B)  4.0, 3.2

         (C)  3.2, 4.0                                    (D)  3.2, 3.2

Q.41    A project consisting of five activities needs crashing. The details of crashing that was carried out are given in the table.

| Activity | Normal Time (*days*) | Shortest Time (*days*) | Cost in *Rs.* for *Reduction/day* | Actually Crashed by (*days*) |
|----------|----------------------|------------------------|-----------------------------------|------------------------------|
| 1-2      | 6                    | 4                      | 100                               | 1 *day*                      |
| 1-3      | 7                    | 5                      | 100                               | 2 *days*                     |
| 1-4      | 10                   | 7                      | 100                               | 1 *day*                      |
| 2-4      | 4                    | 3                      | 200                               | Not Crashed                  |
| 3-4      | 5                    | 4                      | 200                               | 1 *day*                      |

If the overhead cost of the project is *Rs.* 200 *per day*, then the net change in project cost (in *Rs.*) because of crashing is _____


Q.42    Two systems, P and Q, contain 3 components each. Reliability of the components is measured for 1000 hours operations and time-to-failure distributions for all the components are found to be exponential. System P components are connected in a series parallel structure with each component having a reliability of 0.8. System Q components, on the other hand, are connected in series with each component having a reliability of 0.9. See the configuration of the systems below.
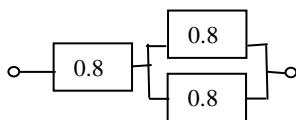


System P

System Q

The reliabilities of System P and System Q will be respectively

(A)  0.768, 0.729       (B)  0.512, 0.729       (C)  0.5, 0.271       (D)  0.232, 0.271


Q.43    Marks obtained by 100 students in an examination are given in the table.

| Sl. No. | Marks Obtained | Number of Students |
|---------|----------------|--------------------|
| 1.      | 25             | 20                 |
| 2.      | 30             | 20                 |
| 3.      | 35             | 40                 |
| 4.      | 40             | 20                 |

What would be the mean, median, and mode of the marks obtained by the students?

(A)  Mean 33; Median 35; Mode 40          (B)  Mean 35; Median 32.5; Mode 40

(C)  Mean 33; Median 35; Mode 35          (D)  Mean 35; Median 32.5; Mode 35

Q.44    In a given day in the rainy season, it may rain 70% of the time. If it rains, chance that a village fair will make a loss on that day is 80%. However, if it does not rain, chance that the fair will make a loss on that day is only 10%. If the fair has not made a loss on a given day in the rainy season, what is the probability that it has not rained on that day?

(A)  3/10                (B)  9/11                (C)  14/17                (D)  27/41

Q.45    For the linear programming problem given below, find the number of feasible corner point solutions. Is the optimal solution degenerate?

Maximize             $z = 2x_1 + 3x_2$

Subject to:          $x_1 + 2x_2 \leq 60;$
                     $2x_1 + x_2 \leq 30;$
                     $x_1 - x_2 \geq -10;$
                     $x_1 \geq 0; \ x_2 \geq 0$

(A)  4; No              (B)  4; Yes              (C)  5; No              (D)  5; Yes

Q.46    A manufacturing company must select a process for its new product, VS-5, from among two alternatives. The following cost data have been gathered.

| Cost | Process X | Process Y |
|------|-----------|-----------|
| Fixed | Rs. 10,000 | Rs. 40,000 |
| Variable | Rs. 5/unit | Rs. 2/unit |

If the objective is to select a process with the least total cost for a given demand, which one of the following is the most appropriate choice?

(A)  Below 10,000 units, Process X; Above 10,000 units, Process Y

(B)  Below 10,000 units, Process Y; Above 10,000 units, Process X

(C)  Below 20,000 units, Process X; Above 20,000 units, Process Y

(D)  Below 20,000 units, Process Y; Above 20,000 units, Process X

Q.47    The following data refers to a manufacturing plant.

|  | Current Year | Previous Year |
|--|--------------|---------------|
| Revenue generated (in Rs.) | 200,000 | 220,000 |
| Number of units produced | 1000 | 1200 |
| Piece rate of workers (in Rs.) | 22 | 18 |

Assuming the previous year to be the base year, the labor productivity index for this plant is _____

Q.48 A manufacturing company producing ball bearings has conducted a time study for 10 cycles of a job consisting of three elements. The details are shown in the table below.

| Job elements | Average elemental time (in *minutes*) | Performance rating factor |
|---|---|---|
| 1 | 0.12 | 0.8 |
| 2 | 0.34 | 1.1 |
| 3 | 0.48 | 1.2 |

If the permissible allowance is 15%, then the standard time (in *minutes*) is _____

Q.49 A control chart for number of non-conformities per unit is to be constructed for a manufacturing process. Sixteen non-conformities were recorded while inspecting 30 units. How should the Upper Control Limit (UCL) and the Lower Control Limit (LCL) be set for this control chart?

(A) UCL = 1.81, LCL = 0.70

(B) UCL = 2.71, LCL = 0.00

(C) UCL = 0.533, LCL = – 0.533

(D) UCL = 3.10, LCL = – 1.46

Q.50 For a given volume of a riser, if the solidification time of the molten metal in riser needs to be quadrupled, the surface area of the riser should be made

(A) one-fourth        (B) half        (C) double        (D) four times

Q.51 A 80 *mm* thick steel plate with 400 *mm* width is rolled to 40 *mm* thickness in 4 passes with equal reduction in each pass, by using rolls of 800 *mm* diameter. Assuming the plane-strain deformation, what is the minimum coefficient of friction required for unaided rolling to be possible?

(A) 0.111        (B) 0.158        (C) 0.223        (D) 0.316

Q.52 In an arc welding operation, carried out with a power source maintained at 40 *volts* and 400 *amperes,* the consumable electrode melts and just fills the gap between the metal plates to be butt-welded. The heat transfer efficiency for the process is 0.8, melting efficiency is 0.3 and the heat required to melt the electrode is 20 *J/mm³*. If the travel speed of the electrode is 4 *mm/s*, the cross-sectional area, in *mm²*, of the weld joint is _____

Q.53 A hard ceramic marble, having density ($\rho$) of 3000 *kg/m³* and diameter (*d*) *of* 0.025 *m*, is dropped accidentally from a static weather balloon at a height of 1 *km* above the roof of a greenhouse. The flow stress of roof material ($\sigma$) is 2.5 *GPa*. The marble hits and creates an indentation on the roof. Assume that the principle of creation of indentation is the same as that in case of abrasive jet machining (AJM). The acceleration due to gravity (*g*) is 10 *m/s²*. If *V* is the velocity, in *m/s*, of the marble at the time it hits the greenhouse, the indentation depth ($\delta = 1000 \times \sqrt{\dfrac{\rho}{6\sigma}} \times d \times V$), in *mm*, is _____

Q.54    An HSS drill of 20 *mm* diameter with 5 *mm* cone height is used to drill a through hole in a steel
        work-piece of 50 *mm* thickness. Cutting speed of 10 *m/min* and feed rate of 0.3 *mm/rev* are used.
        The drilling time, in *seconds*, neglecting the approach and over travel, is _____

Q.55    The alignment test "Spindle square with base plate" is applied to the radial drilling machine. A dial
        indicator is fixed to the cylindrical spindle and the spindle is rotated to make the indicator touch
        the base plate at different points. This test inspects whether the
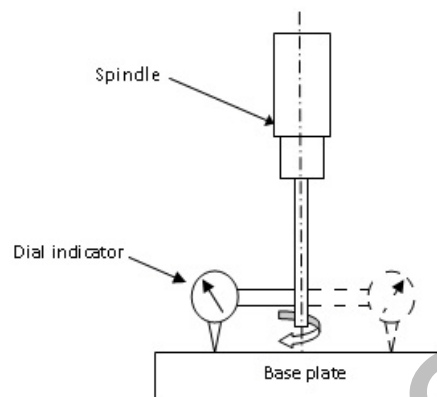


        (A)  spindle vertical feed axis is perpendicular to the base plate

        (B)  axis of symmetry of the cylindrical spindle is perpendicular to the base plate

        (C)  axis of symmetry, the rotational axis and the vertical feed axis of the spindle are all
             coincident

        (D)  spindle rotational axis is perpendicular to the base plate

# END OF THE QUESTION PAPER